Proposed Army Research Institute Support for Army After Next Experimental Unit

Scott E. Graham
U.S. Army Research Institute

Infantry Forces Research Unit
Scott E. Graham, Chief

May 1998

19980522 075

U.S. Army Research Institute
for the Behavioral and Social Sciences

DTIC QUALITY INSPECTED 4

U.S. Army Research Institute
for the Behavioral and Social Sciences

A Directorate of the U.S. Total Army Personnel Command

EDGAR M. JOHNSON
Director

Technical Review by

Michael G. Sanders

NOTICES

REPORT DOCUMENTATION PAGE

1. REPORT DATE (dd-mm-yy) May 1998	2. REPORT TYPE Final	3. DATES COVERED (from. . . to) October 1997 to March 1998

4. TITLE AND SUBTITLE Proposed Army Research Institute Support for Army After Next Experimental Unit	5a. CONTRACT OR GRANT NUMBER
	5b. PROGRAM ELEMENT NUMBER 62785

6. AUTHOR(S) Scott E. Graham	5c. PROJECT NUMBER A790
	5d. TASK NUMBER 212C
	5e. WORK UNIT NUMBER H01

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Research Institute for the Behavioral and Social Sciences Infantry Forces Research Unit P.O. Box 52086 Fort Benning, GA 31995-2086	8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Research Institute for the Behavioral and Social Sciences 5001 Eisenhower Avenue Alexandria, VA 22333-5600	10. MONITOR ACRONYM ARI
	11. MONITOR REPORT NUMBER Research Note 98-08

12. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT *(Maximum 200 words)*: The Army is discussing the creation of an experimental unit that can be used to evaluate and refine concepts being developed for the Army After Next (AAN). The purpose of this scripted briefing is to describe what the Army Research Institute (ARI) could do in support of an AAN Experimental Unit (EXUnit), should such an organization be established. The recommendations are based on well-established military psychology principles derived from decades of behavioral science research. In addition, critical research issues are identified that we believe need to be addressed.

ARI is prepared to help lead in the design and the utilization of the EXUnit. Our proposed effort uses a systems approach to organize, understand, and address AAN training and personnel performance issues. It is a systems approach in that there are explicit relationships between the various proposals. Among the components to be proposed are sequential selection, assignment, and training systems or subsystems. These systems will rely heavily on the development and use of virtual and constructive simulation environments for concept development and evaluation. Virtual prototypes of future weapon systems and organizational structures will need to be constructed as a means to empirically determine effective, if not optimal, job structures, personnel requirements, skill mixes, communication patterns, and tactics, techniques and procedures (TTPs).

Much of the focus is on enhancing the collective performance of AAN teams. This will require the development of AAN collective performance measures that can be used to assess the effectiveness of AAN teams or forces under realistic AAN conditions. In addition, there are several recurring themes that occur throughout this briefing. These include the development and refinement of AAN job structures based on a projected AAN front end analysis, along with the development of complementary AAN performance measures. We also highlight similarities between proposals and current Special Operations Forces (SOF) organizations and procedures. In certain cases we recommend the use of SOF as a testbed for the EXUnit proposals.

15. SUBJECT TERMS		
Army After Next	Training	Special Operations Forces
Experimental Force	Assignment Systems	

SECURITY CLASSIFICATION OF			19. LIMITATION OF ABSTRACT	20. NUMBER OF PAGES	21. RESPONSIBLE PERSON (Name and Telephone Number)
16. REPORT Unclassified	17. ABSTRACT Unclassified	18. THIS PAGE Unclassified	Unlimited	40	Scott E. Graham (706) 545-2362

i

Proposed ARI Support for
Army After Next
Experimental Unit
(AAN EXUnit)

Dr. Scott E. Graham

Chief, ARI Infantry Forces Research Unit

DSN: 835-2362

March 1998

The Army is discussing the creation of an experimental unit that can be used to evaluate and refine concepts being developed for the Army After Next (AAN). For the purpose of this briefing we will refer to this proposed unit as the AAN EXUnit. The EXUnit concept is similar to that of the Experimental Force (EXFOR) which was created to support the Force XXI Advanced Warfighting Experiments (AWE). In contrast to the brigade-sized EXFOR, the EXUnit will likely be much smaller. Also, while most of the emphasis of the FXXI AWEs was on the development and integration of state-of-the-art digital systems and near term technology prototypes, the AAN EXUnit, being targeted at the year 2025, will focus on higher risk, more advanced developmental concepts.

One of the primary purposes of the AAN EXUnit would be to be provide Army leaders insights regarding future doctrine, organization, training, leader, materiel, and soldier (DOTLMS) requirements. The focus of this briefing is on the human dimension issues, I.e., on the (T)raining, (L)eaders, and (S)oldier domains.

Purpose

• To describe what ARI could do in support of an AAN Experimental Unit (EXUnit)

• To describe what we do not know and how research might clarify those critical issues

Structure

• AAN assumptions and salient Issues

• ARI support of the EXUnit across the Army Life Cycle
   - ARI EXUnit proposals
   - What we know
   - Research issues

The purpose of this scripted briefing is to describe what the Army Research Institute (ARI) could do in support of an AAN Experimental Unit (EXUnit), should such an organization be established. The recommendations are based what we "know" about AAN manpower, personnel, and training issues, with the "we" more or less representing the ARI corporate view. In as much as we cannot really know anything about the future, what I am presenting are projections or recommendations as what we believe needs to be done regarding future human dimension issues.

To the extent possible, these recommendations are based on well established military psychology principles derived from decades of behavioral science research. In addition, I will identify critical research issues that we believe need to be addressed.

As for the structure of the briefing, I will begin by discussing some of the underlying assumptions about the AAN and AAN human and organizational requirements. I will then discuss a number of ways ARI could support the AAN EXUnit. For each of the ARI EXUnit proposals, I will present what we know and/or believe to be true, followed by supporting evidence or assumptions relevant to the main point. I will then identify specific research questions that we believe should be addressed.

2

Proposal

- **ARI is prepared to help lead the design and utilization of AAN EXUnit**

  ➢ **Proposed development of sequential selection, assignment, and training systems**

  ➢ **Heavy reliance on virtual and constructive environments**

  ➢ **Virtual prototyping to empirically determine optimal/effective job structures, personnel requirements, skill mixes, communication patterns, TTPs**

  ➢ **Focus on collective effectiveness of AAN team and assault force in realistic AAN conditions**

- **Recurring themes: New Job Structures, Performance Measurement, SOF Testbed, Reliance on Virtual Simulation**

ARI is prepared to help lead in the design and the utilization of the EXUnit. Our proposed effort uses a systems approach to organize, understand, and address AAN training and personnel performance issues. It is a systems approach in that there are explicit relationships between the various proposals. Among the components to be proposed are sequential selection, assignment, and training systems or subsystems.

These systems will rely heavily on the development and use of virtual and constructive simulation environments for concept development and evaluation. Virtual prototypes of future weapon systems and organizational structures will need to be constructed as a means to empirically determine effective, if not optimal, job structures, personnel requirements, skill mixes, communication patterns, and tactics, techniques and procedures (TTPs).

Much of the focus is on enhancing the collective performance of AAN teams. This will require the development of AAN collective performance measures that can be used to assess the effectiveness of AAN teams or forces under realistic AAN conditions.

In addition, there are several recurring themes that occur throughout this briefing. These include the development and refinement of AAN job structures based on a projected AAN front end analysis, along with the development of complementary AAN performance measures. We also highlight similarities between our proposals and current Special Operations Forces (SOF) organizations and procedures. In certain cases we recommend the use of SOF as a testbed for the EXUnit proposals.

3

AAN Assumptions

Increased tempo and complexity

Must manage high-tech assets, e.g., intel, sensors, UAVs

AAN is subset of future land forces

Remote, precision fires are fundamental

Must win the war as well as the battle

Dispersed battlefield

Greater diversity in force

Decentralized C2

Must still close with the enemy frequently in urban terrain
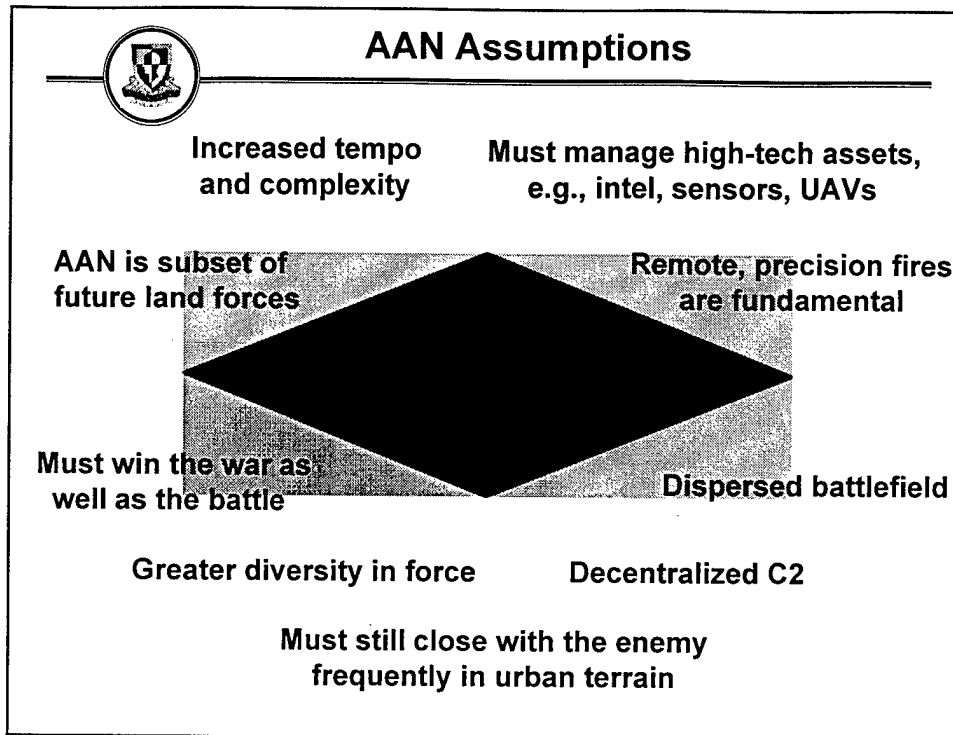
I would like to briefly discuss some assumptions about the AAN. Foremost, the AAN will be a significantly smaller force that must be capable of decisive success across the full spectrum of operations. This will require the flexible use of force ranging from non-lethal in military operations other than war to the application of exceedingly lethal forces. The smaller AAN force will have to have the skills and capabilities to quickly defeat enemy forces several times its size.

To accomplish this, AAN forces will significantly drive up the tempo of battle. Recent results from AAN wargames found that mobility, characterized predominantly by speed of maneuver, contributed most to battlefield success. There will also be increased complexity. Leaders at all echelons will have control of more independent variables, e.g., battlefield information sources and weapon options, from which they must consider the effects on more dependent variables.

Other assumptions about the AAN include:

• AAN leaders and units must be skilled in managing high-tech assets to include sensors, unmanned aerial vehicles (UAVs), as well as various tactical and national intelligence assets.
• Remote, precision fires will be a fundamental means for delivering lethal force. This will require rapid targeting decisions, consideration of available options, and procedures for calling for the fires.
• The battlefield, as well as soldiers within AAN units, will be more dispersed than today.

4

• There will be increasingly decentralized command and control, even though improved communication electronics will allow higher headquarters to readily monitor and communicate with lower echelons.

• There will be greater diversity in the force, to include ethnic, cultural, and first language diversity.

• The AAN force will be required to win the war as well as the battle. AAN forces will be required to consider and in some cases operate simultaneously on the tactical and strategic level. Young officers and NCOs will make decisions that will have State Department level implications.

• AAN is a subset of the future land force, i.e., there may still be a heavy/mechanized component of the Army.

Lastly, there is a tendency to envision the AAN as a small, very high-tech, highly mobile force whose primary job is to call precision, remote fires on an increasingly confused enemy. While this may prove to be true much of the time, there will still be a need for the AAN forces to close with the enemy. All of military history supports this. Furthermore, many of the AAN engagements will likely be in urban terrain which raises even more questions. Small, high-tech forces principally armed with remote precision fire capabilities are not particularly well-suited for military operations in urban terrain.

Human and Organizational Requirements

Flexibility & adaptability

Extraordinary competence

Psychological resilience

Information utilization skills

Soldiers, Units and Leaders that Demonstrate

Ability to make complex discriminations and decisions

Ability to simultaneously deal at multiple levels

Ability to apply "Principles of War"
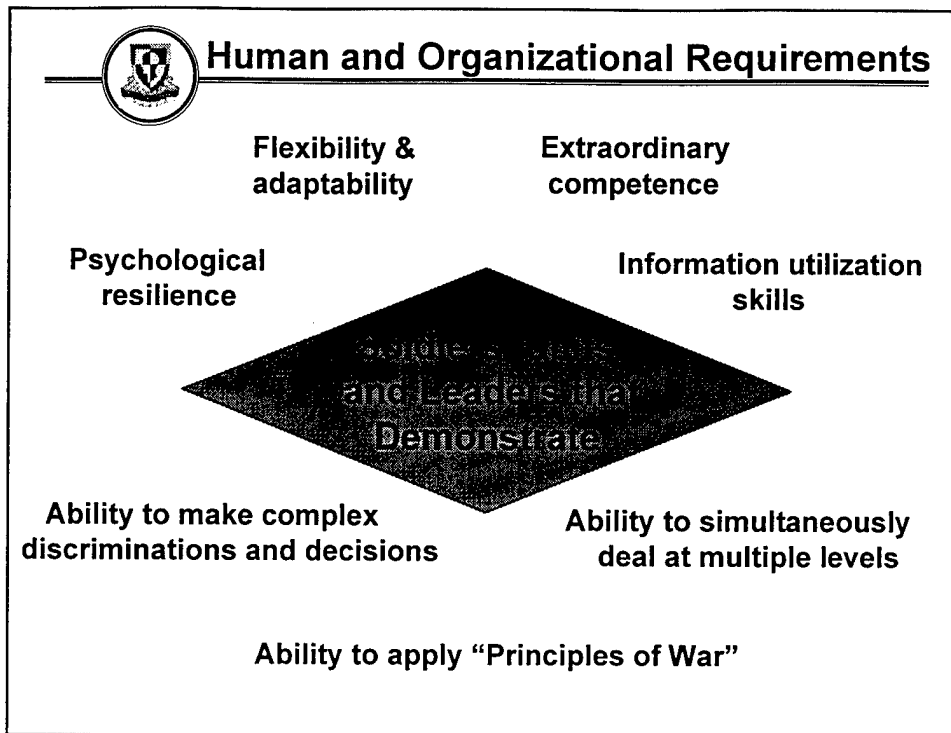
Here are some of the key human and organizational requirements that we believe AAN soldiers, units, and leaders will have to be able to demonstrate. These include psychological resilience, flexibility, and adaptability. The tempo and complexity of the AAN battlefield will require soldiers and units to rapidly process near real time information in making battlefield decisions and in shifting their plans and actions. For example, rules of engagement may rapidly change such that plans that are appropriate in the morning may be highly inappropriate in the afternoon. On an exceedingly high tempo and complex battlefield, rapidly changing plans may well be the rule rather than the exception.

Foremost, AAN soldiers must be extraordinarily competent. They must be able to understand and make good use of battlefield information. They must be able to simultaneously deal with multiple echelons. For example, even small unit leaders must be able to operate both tactically and strategically. They must be able to understand the impact of their actions on local cultures, on joint and multi-national operations, and must be cognizant of their decisions and actions vis'-a-vis' worldwide press coverage, i.e., the CNN factor.

More so, AAN leaders and soldiers must be able to make complex discriminations and decisions. For example, they must have the competence and confidence to monitor and overrule technology. They will be required more than ever to fully understand the commander's intent and to be ready to change their plans and act quickly in accordance with that intent.

6

Despite these apparent differences between AAN and traditional requirements, some things will change little. The AAN will still have to understand and be able to employ the "Principles of War." It can be argued that maintaining the "Offensive," "Economy of Force," "Mass," and "Surprise" will be even more important in the AAN.

ARI Support for AAN EXUnit

Force Development
- Organizational Design
- Notional AAN Force
- SOF Leverage

Acquire
- Selection and Assessment

Separate

Train
- AAN Tng Strategy
- Virtual Environments

Sustain
- Education System
- Quality of Life

Distribute
- Assignment System
- New MOS/Job Structures

The Army Life Cycle

Deploy
- Full Spectrum Ops
- Performance Evaluation System

Develop
- Quality AAN Leaders
- Cohesive Units
- Effective Human/ Technology Interfaces

AAN EXUnit Proposals -- What We Know -- Research Issues

For the remainder of the briefing, I will discuss how ARI can support the AAN EXUnit; the proposals are based on what we believe to be the critical AAN human systems issues. I have organized the presentation around "The Army Life Cycle." For each topic, I will first present what we propose to do or what is needed. I will then discuss supporting issues or assumptions, followed by what we believe are critical research issues within that domain.

First I will address force design issues.

Force Dev ➡ Organizational Design

[illegible]

- Assumes Army can define prototype AAN scenarios
- Virtual and constructive simulations can be used to evaluate alternative force designs, communication patterns, span of control, and TTPs.
- Procedures are needed for scalability, e.g., addition of modular units, and cohesiveness

At issue:
(1) Impact of decentralized vs. centralized C2
(2) Advantages/disadvantages of generalists versus specialists
(3) Impact of a flat organization on leadership, morale, and performance
(4) Organizational factors that influence unit flexibility/rigidity

Before much substantive process can be made regarding the AAN, there must be some agreement to at least notional AAN scenarios, mission-essential tasks, and supporting tactics, techniques, and procedures (TTPs). From these initial assumptions, a front end analysis (FEA) can be conducted to determine what AAN leaders, soldiers and units must be able to accomplish. Once these first iterations are established, variations in force design can be constructed and evaluated as to their efficacy.

Once developed, virtual and constructive simulations that adequately represent AAN conditions, can be used to evaluate and refine such things as alternative force designs, communication patterns, span of control issues, and TTPs.

One of the more critical requirements for AAN force design involves scalability. Mechanisms must be established that readily allow the building of modular units as a function of mission requirements and force availability. These procedures should ideally consider and address the impact of modular force construction on unit performance and cohesiveness.

Some of the force design research issues that should be considered include:
(1) The impact of decentralized versus centralized command and control on unit performance,
(2) The advantages and disadvantages of training technology/warfighter generalists vs. specialists,
(3) The impact of a likely flat organizational structure on leadership, morale, and performance, and
(4) Determining which organizational factors influence flexibility and/or rigidity.

Force Dev ➡ Notional AAN Force

Compose AAN EXUnit initially with ... mix of ... and ... force packages, plus command and control slice.

- ➤ AAN Team
  - ➤ Small team (e.g., 10)
  - ➤ Comprised of NCOs, WOs, and CPTs
  - ➤ Armed with leading-edge technologies, remote precision fires
- ➤ AAN Assault Force
  - ➤ Larger unit (e.g., 40)
  - ➤ Armed with Land Warrior Plus technologies
  - ➤ Rapidly insertable
  - ➤ Provides limited, albeit highly lethal, close combat capability
  - ➤ Test-bed for Land Warrior refinements, e.g., TTPs
- • Proposed minimum AAN EXUnit - 2 Teams, 2 Assault Forces, plus Bn staff
- • Larger AAN force concept built around modularity
  - ➔ AAN Teams and Assault Forces basic building blocks
  - ➔ Non-AAN forces, RC units, contractor support

The AAN force will very likely contain modular force packages with varying capabilities, skills, and available technologies. The organizational structure of the EXUnit will undoubtedly be a function of a number of factors beyond the simple utility of the unit as a research tool. For the purpose of the discussion, however, we recommend that that the EXUnit, as an initial model for a notional AAN force, be comprised of two types of units as its foundation.

A notional "AAN Team" might be a small team that in structure looks something like a Special Forces A-team, in that it is led by a captain and otherwise comprised of NCOs and warrant officers. The AAN team would be the highest-tech AAN package, armed with leading-edge technologies and whose primary mission it would be to call remote precision fires. The AAN team would be stealthily inserted deep into the battlespace.

A notional "AAN Assault Force" might be a slightly larger unit armed with the latest in Force XXI Land Warrior Plus technologies. The assault team would be rapidly insertable and would provide, limited, albeit highly lethal close combat capability. The AAN Assault Force could be likened to a very high tech Ranger platoon.

As a minimum we believe that the AAN EXUnit would need to have two Assault Teams, two Assault Forces, and a command and control slice. The larger AAN force or Army of the future would be a modular force with AAN Teams and Assault Forces as the basic building blocks. The other modular components would include other active component non-AAN forces, as well as reserve component units, DA civilians, and contractors.

Force Development ➡ SOF Leverage

Conduct comprehensive comparative analysis

Use SOF as an AAN testbed

- Apparent similarities exist between Special Forces, Special Mission Units, and proposed AAN forces
    - ⇨ Similar size and rank structure
    - ⇨ Relative flat organizations
    - ⇨ Access to high technology
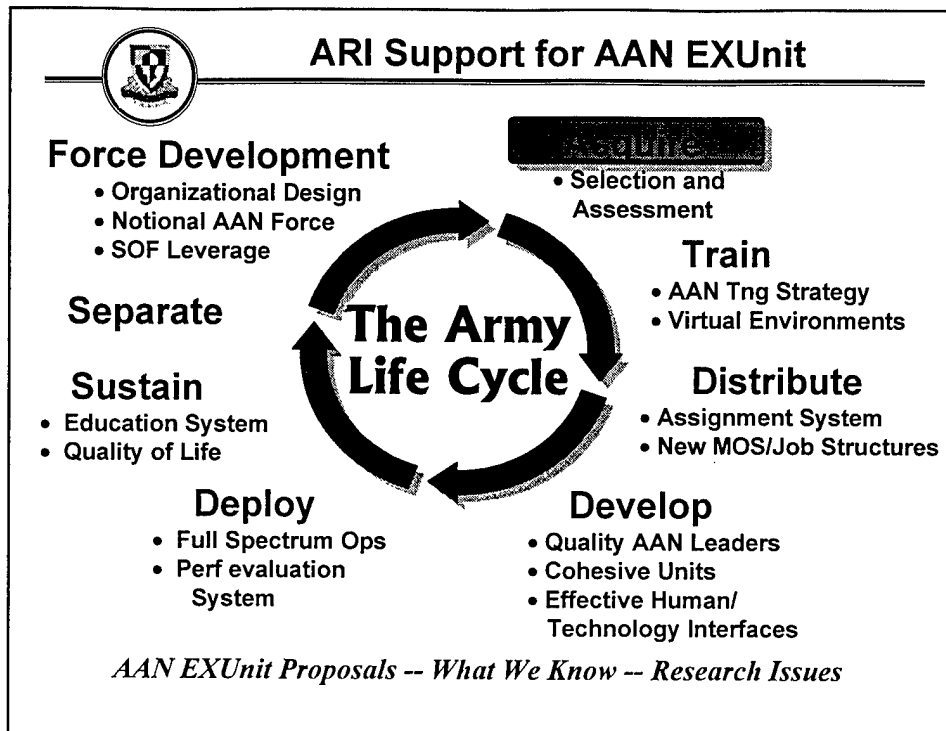   - ⇨ Decentralized decision-making
    - ⇨ Fieldcraft

At issue, applicable SOF:
    - ⇨ Selection and assignment
    - ⇨ Command and control
    - ⇨ Tactics, techniques, and procedures (TTPs)
    - ⇨ Communications patterns
    - ⇨ Logistics
    - ⇨ Training/cross-training
    - ⇨ Information management

Because of the similarity between current Special Operation Forces (SOF) missions and organizations, we recommend that a comparative analysis be conducted between the SOF and AAN. The similarities between Special Forces (SF) and Special Mission Units and the proposed AAN force, at least the notional AAN team that I have presented here include: similar size and rank structure, relatively flat organizations, access to high technologies, decentralized decision-making, and execution of cutting edge fieldcraft.

The comparative analysis might consider applicable SOF techniques that could be implemented or experimented within the context of AAN. Some of the likely applications include: selection and assignment, command and control, TTPs, communications patterns, logistics, training and cross-training practices, and information management. I will discuss several of these concepts in greater detail.

SOF organizations might also be used as a test bed for new AAN force structures, TTPs, and training. ARI currently has a research program in place with the SOF community at Fort Bragg from which a number of products have been successfully implemented.

ARI Support for AAN EXUnit

Force Development
- Organizational Design
- Notional AAN Force
- SOF Leverage

Separate

Sustain
- Education System
- Quality of Life

Deploy
- Full Spectrum Ops
- Perf evaluation
  System

The Army Life Cycle

Acquire
- Selection and
  Assessment

Train
- AAN Tng Strategy
- Virtual Environments

Distribute
- Assignment System
- New MOS/Job Structures

Develop
- Quality AAN Leaders
- Cohesive Units
- Effective Human/
  Technology Interfaces

AAN EXUnit Proposals -- What We Know -- Research Issues

Next I will discuss the "Selection and Assessment" of AAN soldiers under the rubric of the "Acquisition" of quality soldiers.

Develop AAN S&A system based on Special Forces techniques with parallel procedures for AAN Team & Assault Force

Develop S&A database/integration system for long range, thorough analysis

- Begin with "projected" AAN FEA, including human dimension reqts
- Establish initial guidelines for proposed MOSs & CFs
- Identify screening points and types of aptitudes to be assessed
- System should include:
    - ⇨ Early screening of AAN candidates
    - ⇨ Continued screening through job-related situational & perf tests
    - ⇨ Objective perf standards that relate to critical mission attributes

- Preliminary ARI results show top 21st Cent NCO requirements to be: Integrity, Discipline, Motivation, Intelligence, and Adaptability

At issue:
(1) How to effectively use lower aptitude personnel in the AAN?
(2) How to leverage older, more experienced soldiers and leaders?

ARI has been working with the US Army Special Operations Command (USASOC) for a number of years on the development and refinement of a SF selection and assignment system. Prospective SF candidates are evaluated in the Special Forces Assessment and Selection course (SFAS). Those selected from the SFAS screening are sent to the SF Qualification course for MOS-specific training. The general notion is to separate the selection process from the training.

A similar sequential selection and training course might be used for the AAN. As mentioned earlier, there would need to be a "projected" AAN FEA to determine the necessary knowledge, skills, abilities (KSAs) to include human dimension requirements. Separate FEAs would be required for the notional AAN team and assault force. From these one could establish initial guidelines for proposed MOSs and officer career fields. The process should also identify screening points and the types of aptitudes that need to be assessed. Such a system should include: early screening of AAN candidates, continued screening throughout their career including the use of job-related situational and performance tests, and the development and use of objective performance standards that relate to critical mission attributes.

Relatedly, ARI has begun a research program to determine 21st Century NCO requirements. The preliminary results indicate the top rated requirements to be: integrity, discipline, motivation, intelligence, and adaptability. These will likely prove to be characteristics that are selected and evaluated in the AAN.

Some of the more intriguing research issues include: How do we effectively use lower aptitude personnel in the AAN? The AAN force that we are describing generally requires very high performance levels. What will the Army do with the soldiers who cannot perform at such high levels? Also, given that we are proposing an AAN force that relies heavily on more experienced soldiers, i.e., NCOs rather than junior enlisted, how do we leverage the knowledge and skills of older, more experienced soldiers and leaders? Conversely, what are the downsides of a more senior force?

ARI Support for AAN EXUnit

Force Development
- Organizational Design
- Notional AAN Force
- SOF Leverage

Separate

Sustain
- Education System
- Quality of Life

Deploy
- Full Spectrum Ops
- Perf evaluation System

The Army Life Cycle

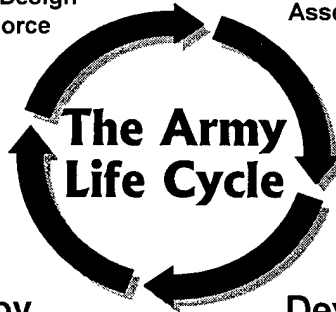**Acquire**
- Selection and Assessment

- AAN Tng Strategy
- Virtual Environments

Distribute
- Assignment System
- New MOS/Job Structures

Develop
- Quality AAN Leaders
- Cohesive Units
- Effective Human/ Technology Interfaces

AAN EXUnit Proposals -- What We Know -- Research Issues

I will now discuss AAN training issues.

15

Develop simple ... critical AAN requirements ... scalability ...

- Many of the AAN concerns, e.g., battlefield complexity, need for psychological resilience, controlling information and precision fire assets, can be effectively addressed by extending current methods of training
- Training in a realistic, functional context - "Train as you will fight."
- Frequent, task-specific feedback
- Repeated practice in increasingly difficult contexts
- Use of peer training
- Consider skill acquisition/skill retention tradeoff
- Part-task trainers and low cost simulators can be effective

At issue: How do we train "Hyper-proficiency?" How long?
  ⇨ More cognitively challenging tasks?
  ⇨ To think both strategically and tactically?
  ⇨ To be more adaptive to different environments?
 ⇨ For operations with semi-autonomous robots?

We believe that many, if not most, of the AAN performance issues previously identified, e.g., increased tempo and dispersion, battlefield complexity, controlling information/precision fire assets, can be effectively addressed by extending current training methods. The key is the development of quality, structured and immersive training that address critical AAN missions and requirements, e.g., modular units, full-spectrum operations. The AAN environment and missions may change, but the principles of successful training will remain: conduct training in a realistic, functional context, i.e., "Train as you will fight;" provide frequent, task-specific feedback; give leaders, soldiers and units repeated practice in increasingly difficult contexts; use peer training.

The emerging results from the Division Advanced Warfighting Experiment (AWE) recently conducted at Fort Hood found that the immersive training of division and brigade staffs very quickly resulted in tremendously improved battlefield awareness, shortened decision cycles, and enhanced synchronization. The Division AWE staffs were said to have attained "hyper-proficiency" in their understanding and utilization of previously unfamiliar Force XXI technologies. These results bode well for the transition to AAN as many of the Force XXI performance improvements are akin to that envisioned necessary for AAN. In general, "Hyper-proficiency" comes with narrowing of focus and over-learning as a result of in-depth and frequent practice. Research is needed to determine the breadth, depth, and frequency of training required to attain hyper-proficiency.

16

Among the critical training research questions are: How do we train and how long does it take to reach "hyper-proficiency?" How do we train more cognitively challenging tasks? To think both strategically and tactically? To be more adaptive to different environments? To operate and employ semi-autonomous robots?

Train ➡ Virtual Environments
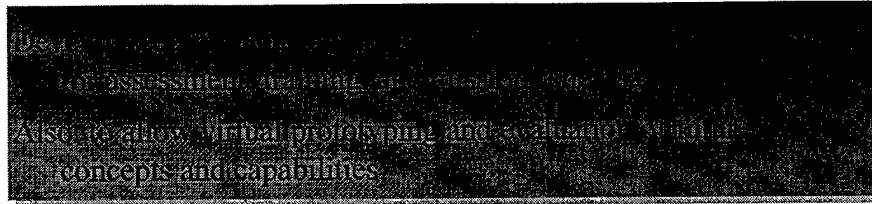
Likely virtual environment requirements:
• Realistic representation of sensors, UAVs, national intelligence assets
• Representation of physical, cognitive, and psychological factors associated with continuous operations
• Virtual emulations of modular unit leadership
• Capabilities for exercises with joint and/or multi-national forces
• Capability to transition virtual training environment to mission rehearsal environment

At issue:
How to train generalizable skills in VE training scenarios, then plug in mission specifics for just-in-time mission rehearsal

We believe that virtual environments (VE) will become the centerpiece of the AAN training strategy. For this to happen, VE requirements and methods must be developed that will create virtual environments that can be used for assessment, training, and mission rehearsal. Quality VE will also allow virtual prototyping and evaluation of future concepts and capabilities. ARI could play a vital role in determining the VE requirements and the methods for the effective use of the AAN VE environments.

Virtual environments will provide the basic capability for training cognitively challenging tasks, e.g., information utilization, tactical and strategic decision-making. Clearly the VE requirements should be based on a comprehensive needs analysis. They will, however, need to include realistic representations of future command, control, communications, computers, and intelligence (C4I) and weapon suites to inlcude sensors, UAVs, and national intelligence assets.

The VE requirements should also accurately represent the physical, cognitive, and psychological factors associated with AAN missions and continuous operations. They should also include virtual emulations of modular unit leadership. For example, if we expect our AAN leaders to effectively operate with modular support, we must represent those conditions and experiences in training simulations. Interactions with other AAN teams, assault forces, RC units, and contractor support would likely have to be emulated in the VE software, in addition to providing the capability for remote training.

Virtual environments will also be used for mission rehearsal, as well as for training. At issue is how to develop the capability to transition virtual training environment to mission rehearsal environment. Also, how does one train generalizable skills in VE training scenarios, then plug in mission specifics for just-in-time mission rehearsal?

Virtual Individual Combatant Technology
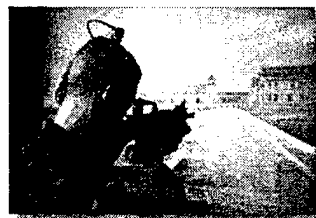
Evaluation - Summer 1997

I am going to briefly digress and discuss the current state of virtual environment technologies for the individual soldier. Several months ago we conducted an evaluation of Virtual Individual Combatant (VIC) technologies in conjunction with STRICOM's Dismounted Warrior Network program. What you see here are three of the four VICs evaluated. In one case the soldiers were completely unteathered using a head mounted display. In another case the soldier viewed rear projection screens and walked on an omni-directional treadmill. The experiment integrated the four VICs into a dismounted Infantry fire team. The VIC soldiers conducted individual and collective tasks as part of two distributed interactive simulation scenarios, one in the desert at 29 Palms and the other in urban terrain at the Fort Benning McKenna Military Operations in Urban Terrain (MOUT) site. The focus of the exercise was to identify the strengths and weaknesses of the varying VIC technologies from the perspective of the Infantry soldier as a guide for the development of future VIC technologies.

While each of the VIC approaches had strengths and weaknesses, in general, the more realistic the simulation, the better the soldiers liked the VIC. A critical question concerning future designs is: "What is the purpose of the virtual simulation?" The system requirements required to train a fire team member to perform squad drills to include being able to do a low crawl, are likely very different from those required to train platoon leader decision-making skills. We believe that ultimately cost-effective VE training will focus more on the decision-making skills training. Because of the relative immaturity of the technology, the focus of the VIC evaluation was on lower order skills.

In general, the VE technologies for individual combatants are not ready for fielding. Technology is, however, changing rapidly.

19

Small Team Portal into the 21st Century

- **Supported Defense Science Board's 1996 Study -
  "Tactics and Technology for 21st Century Superiority"**

- **Soldier-in-the-loop virtual excursions into 21st Century**

- **Future missions with future virtual prototype systems,
  e.g., Personal Data Assistant, Map of the Future**

- **Results:**
  - ➤ **Successfully demonstrated future concepts and
    value of soldier-in-the-loop simulations**
  - ➤ **Simulation hampered by present day technologies**
  - ➤ **Demonstrated impact of human dimensions factors
    and need for full systems approach**

In 1996, we supported an exercise conducted by the Institute for Defense Analysis (IDA) that looked at farther out advanced concepts in support of the Defense Science Board's summer study. The exercise, or excursion, was called the "Small Team Portal into the 21st Century (Virtual) Battlefield."

We conducted excursions with virtual prototypes of relatively exotic personal information management and weapon systems, e.g., the Personal Data Assistant, which was a palm held device with advanced battlefield information. Many of the concepts and virtual prototype devices were similar to some of the concepts being discussed for AAN.

The excursions were, in many ways, successful. They demonstrated the value of evaluating future concepts using soldier-in-the-loop simulations with virtual prototypes. The general point is that powerful lessons are often learned from putting the equipment and procedures in the hands of real soldiers. It is often difficult for "hard science" system designers to anticipate how new systems are actually going to be used and to anticipate information overload/utilization issues. The excursions demonstrated the clear necessity for considering human dimension factors and the need for a full systems approach.

In addition, the excursions demonstrated, as with the VICs just discussed, that the VE technologies are not presently capable of adequately representing the soldier and his virtual prototype tools.

We firmly believe that VE holds the key to future training and AAN concept evaluation, but that the technologies are a couple of generations away. If, however, we are ever to have sufficient VE technologies, the interim technology solutions need to be funded and used in experimentation.

ARI Support for AAN EXUnit

Force Development
- Organizational Design
- Notional AAN Force
- SOF Leverage

Acquire
- Selection and Assessment

Separate

Train
- AAN Tng Strategy
- Virtual Environments

Sustain
- Education System
- Quality of Life

The Army Life Cycle

Distribute
- Assignment System
- New MOS/Job Structures
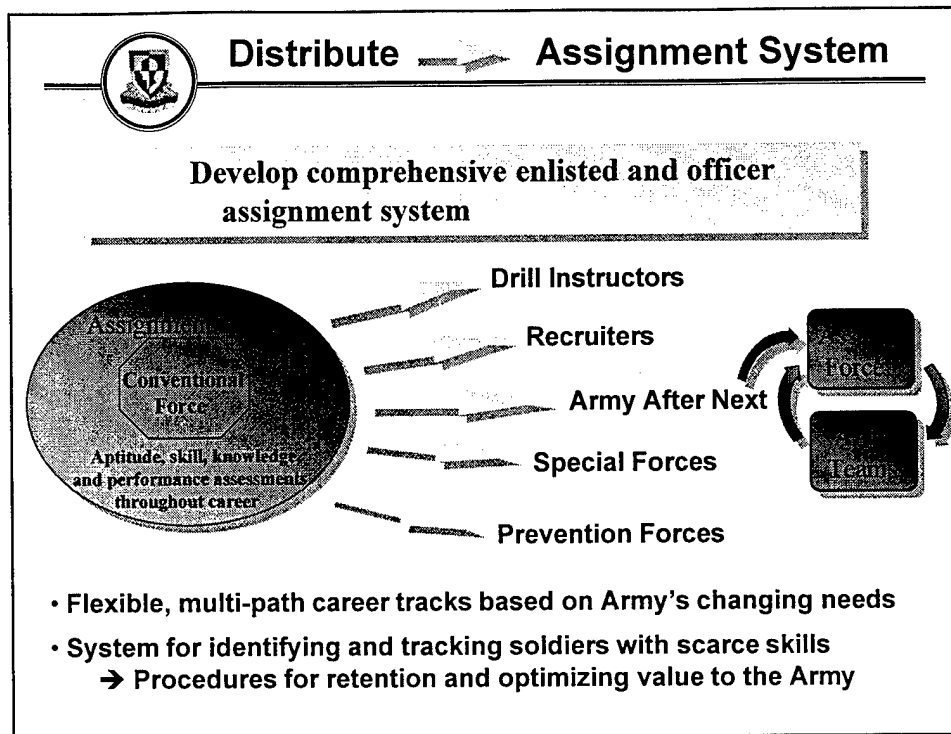
Deploy
- Full Spectrum Ops
- Perf evaluation System

Develop
- Quality AAN Leaders
- Cohesive Units
- Effective Human/ Technology Interfaces

AAN EXUnit Proposals -- What We Know -- Research Issues

Next I am going to discuss proposed changes to the current assignment, job structure, and reclassification system.

Distribute ──➤ Assignment System

Develop comprehensive enlisted and officer assignment system

Assignment
Conventional Force
Aptitude, skill, knowledge and performance assessments throughout career

Drill Instructors
Recruiters
Army After Next
Special Forces
Prevention Forces

Force
Team

• Flexible, multi-path career tracks based on Army's changing needs
• System for identifying and tracking soldiers with scarce skills
  ➔ Procedures for retention and optimizing value to the Army

The Army's current system of assigning enlisted and officers to military occupational specialties (MOS) and officer career fields will likely not be flexible enough to meet future AAN requirements. Changes in this regard are already being made. The Army is in the process of making significant changes to managing career assignments under OPMS XXI which looks to a be a significant improvement. The Army is likely to have to make even greater changes.

To support AAN requirements, we propose that research be undertaken to determine the requirements for a comprehensive enlisted and officer assignment system. What I am showing here is a possible framework for a comprehensive, and more flexible, enlisted and officer assignment system. The basic notion is that the Army should develop, track, and assign soldiers, including officers, into needed Army jobs based on a more complete understanding of aptitude, knowledge and skill requirements. For example, the Army might identify soldiers with particular skill and aptitude sets and assign them to an AAN track. From that pool, soldiers might go into the notional AAN Assault force, from there some may go into more high tech AAN team. In many ways this is similar to a pattern which we have in the SOF community. Some Infantry soldiers become Rangers; some Rangers become Special Forces; some Special Forces go into special mission units.

A successful program might have pre-determined, yet flexible, career paths that are readily responsive to changing Army needs. In addition, the system should have ways of identifying and tracking soldiers with scarce skills and a workable strategy for optimizing their value to the Army.

Distribute ➞ New MOS/Job Structures

Develop comprehensive job structure/ reclassification system

- Valid job structure is backbone of AAN S&A system
- Auxiliary reclassification system for rapid transitioning of MOS/CFs based on changing Army needs, e.g., Armor to Prevention Force
- Leverages proposed comprehensive assignment system

At issue:
(1) System design
(2) Prescriptive training matrices based on:
  ➔ Screening assessments
  ➔ Job history
  ➔ Specific reclassification

In conjunction with the comprehensive assignment system, the Army should consider developing a comprehensive job structure and reclassification system. In part this need is derived from the requirement to have a smaller Army with broader skills and the capability to perform more varied and complex missions. A new job structure/reclassification system would begin with a serious re-look at the knowledge and skill requirement of future AAN jobs.

A reclassification system might identify what it would take to fairly rapidly transition soldiers from one MOS/CF to another as the Army's needs change. For example, what if the Army needed a smaller Armor force and a larger "Prevention Force." A prescriptive reclassification system might be based on screening assessments, job history, and the specific reclassification requirements, I.e., armor to prevention force. From that information, the system would specify what KSAs needed to be trained or taught to a particular Armor crewman to make him qualified for the Prevention Force.

ARI Support for AAN EXUnit

Force Development
- Organizational Design
- Notional AAN Force
- SOF Leverage

Separate

Sustain
- Education System
- Quality of Life

Deploy
- Full Spectrum Ops
- Perf evaluation System

The Army Life Cycle

Acquire
- Selection and Assessment

Train
- AAN Tng Strategy
- Virtual Environments

Distribute
- Assignment System
- New MOS/Job Structures
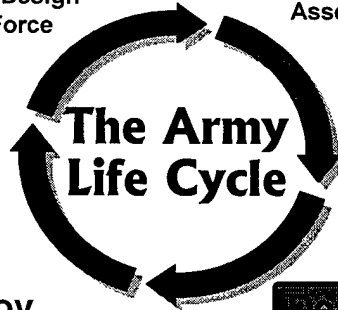
Develop
- Quality AAN Leaders
- Cohesive Units
- Effective Human/ Technology Interfaces

AAN EXUnit Proposals -- What We Know -- Research Issues

Next I will address a number of development issues, including the development of leaders, cohesive units, and effective human/technology interfaces for advanced AAN systems.

Develop ⟶ Quality AAN Leaders

Conduct FEA to determine multi-echelon AAN leader skill requirements

Implement 360° assessment techniques in AAN EXUnit

Develop immersive techniques that allow leaders ample opportunities to train/practice planning and executing in realistic AAN situations

---

• Training programs are key for preparing leaders to efficiently manage the tremendous of amounts of real-time battlefield information/assets

• Leaders must be developed to delegate (or assume) decision-making responsibilities, i.e., how to operate in a decentralized environment

At issue:

(1) Can we predict who will be good AAN Team/Assault Force leaders?

(2) How to select and/or develop leaders with greater cognitive flexibility?
   - Consider "Practical Thinking" training/sustainment for AAN EXUnit

---

The first issue that must be addressed regarding the development of quality AAN leaders goes back to the need for a comprehensive front end analysis, in this case, with the focus on leader skill requirements. We believe that the Army is going to need leaders who are effective in flatter, more dispersed units, who can manage high tech information assets and remote precision fires. We need to determine what KSAs are needed for effective leadership in such an environment.

One thing that we currently know is that top down evaluation procedures, in which you are rated by your boss and senior rated by your boss's boss, is not particularly good at assessing the full range of leader dimensions, e.g., how well you interact with peers or inspire subordinates. We also know that 360° assessment techniques in which leaders are assessed by their superiors, peers, and subordinates are more effective in this regard.

As already discussed, we believe that immersive training programs are the primary key to preparing leaders for the AAN. Immersive techniques are needed that will allow leaders to train and repeatedly practice planning and executing in realistic AAN situations. This would include repeated practice in efficiently managing voluminous real-time battlefield information and assets.

AAN leaders must also be developed so as to be able to operate in a non-linear decision-making environment; this represents a major shift in Army culture. Leaders must learn how to truly delegate (or assume) decision-making responsibilities. This is a fundamental requirement for success in a decentralized environment.

Not unlike training, leadership is an issue that crosses all dimensions. As a result, numerous AAN leadership research issues have been identified throughout this briefing. Some of the leader development research issues not previously addressed include: Can we predict who will be good AAN Team/Assault Force leaders? If so, how do we incorporate that capability into leader selection and development? How do we select and/or develop leaders with greater cognitive flexibility?

Develop ──⟶ Cohesive Units

Develop AAN team training strategy that yields both unit cohesion and shared mental models

- Evidence suggests soldiers persevere in battle primarily because of their buddies - possible key to psychological resilience

- Team shared mental models linked to successful goal achievement - Common picture of battlefield, internalized TTPs, info utilization strategies

- Virtual and constructive simulations can be developed to train: (1) realistic expectations and (2) strategies for dealing with widely varying situations

At issue:

(1) How to develop effective team training that builds trust relationships in AAN environment? (Prerequisite for delegated decision-making & decentralized C2)

(2) How to develop and train shared mental models for: (a) effective information utilization, and (b) overall team competence

---

The AAN will need to be able to quickly build effective and cohesive, albeit modular units. There is a fair amount of evidence that suggests soldiers persevere in battle primarily because of their buddies, i.e. because of unit of cohesiveness. Unit cohesiveness may well be the answer to enhanced psychological resilience and other AAN requirements. The critical question is how to develop an AAN team training strategy that rapidly produces high levels of cohesion.

Again, immersive training is likely to be the key for developing cohesion in units. Units can practice planning and executing collective tasks. From this, they will be able to develop realistic expectations as to how their team will perform and will be able to develop coordinated team strategies for dealing with widely varying situations. Research may find that cohesion can develop quickly when teams are given repeated opportunities to perform in AAN task-specific contexts.

There is also a need for AAN teams to develop shared mental models which have been shown to be linked to successful goal achievement. There is good reason to believe that those teams who have a common picture of battlefield, the same internalized TTPs, and similar information utilization strategies and techniques will be the most successful.

Some of the research questions include: How to develop effective team training that builds cohesion and trust relationships in AAN environment? How do you develop and train shared mental models for both effective information utilization, and overall team competence?

27

```
┌─────────────────────────────────────────────────────────────┐
│  (emblem) Develop ──➤ Human/Technology Interfaces           │
│  ─────────────────────────────────────────────────────────  │
│                                                               │
│  Use virtual prototyping to evaluate proposed technologies & TTPs │
│  to determine comprehensive effects on soldier/unit performance   │
│      ⇨ Assess interaction between technologies and team structure/roles │
│      ⇨ Assess effectiveness of alternative task structures and workload │
│  distributions for differing weapons, sensor, and communication suites │
│                                                               │
│      • Focus should be on information utilization and decision-making │
│                                                               │
│      • The incremental value of each new technology or procedure should be │
│      assessed, i.e., Does it enhance situational awareness, improve tactical │
│      decision-making, or enhance lethality?                   │
│                                                               │
│      • Information utilization can be enhanced by intelligent agents, job aids, │
│      job restructuring, and/or new training approaches?       │
│                                                               │
│      At issue:                                                │
│      (1) What are the limiting factors for effective information utilization? │
│      (2) How to determine and train effective communication patterns for │
│      proposed technology suites                               │
│      (3) Tradeoffs between job aids, redesign, training, and technology │
└─────────────────────────────────────────────────────────────┘
```

In the past, much of the emphasis regarding human factors has focused on the physical fit between the soldier and a piece of equipment or crew station. In the AAN, human factors issues will likely be more focused on the fit between the solider and information, i.e., is the information presented or available in such a way that the soldier makes good decisions based on that information.

If adequate AAN virtual environments can be built in the coming years, virtual prototyping can be used to evaluate proposed technologies and TTPs to determine their comprehensive effects on performance. For example, soldier-in-the-loop virtual simulations can be used to empirically assess the effectiveness of alternative task structures and workload distributions for differing weapons, sensor, and communication suites.

The focus of such assessments should be on the processes of information utilization and decision-making, as well as overall unit performance. In addition, it will be important to assess the incremental value of new technologies or procedures. It is quite possible that soldiers, leaders, and units will frequently be on the brink of information overload. Every new technology or information source would then have the downside that attending to the new information reduces the contribution of some other information source. On the other hand, there may be an appearance of information overload, but few instances of where leaders are actually overwhelmed. Primarily, the evaluation of any new technology or procedure should focus on the overall performance of the unit.

Training is not the only means to enhance information utilization. Information utilization can also be improved through the development of intelligent agents, job aids, as well as through job restructuring. Research is needed to determine how these can best be accomplished in emerging AAN situations.

Some of the research issues include: What are the limiting factors of effective information utilization? How can we determine and train effective communication patterns for proposed technology suites? What are the tradeoffs between job aids, redesign, training, and technology?

ARI Support for AAN EXUnit

Force Development
- Organizational Design
- Notional AAN Force
- SOF Leverage

Separate

Sustain
- Education System
- Quality of Life

The Army Life Cycle

Acquire
- Selection and Assessment

Train
- AAN Tng Strategy
- Virtual Environments

Distribute
- Assignment System
- New MOS/Job Structures

Deploy
- Full Spectrum Ops
- Perf evaluation System

Develop
- Quality AAN Leaders
- Cohesive Units
- Effective Human/ Technology Interfaces
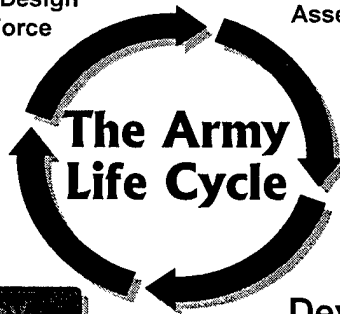
AAN EXUnit Proposals -- What We Know -- Research Issues

I will now discuss, under the rubric of unit deployment, some more general issues related to the training and personnel performance issues in the AAN.

Deploy ➤ Full Spectrum Ops

> **Ensure AAN personnel development and training systems adequately represent most difficult AAN conditions**

At issue:
How do we select, develop, and train soldiers, leaders, and units to:
(1) Conduct MOUT operations with small forces and remote, precision fires
(2) Fully rely on RC units and contractor support
(3) Rapidly shift between fighting heavy larger forces, resolving conflicts, and peace operations
(4) Win the tactical battle while strategically handling news organizations, local political leaders, populations, and cultures

If there is a truly a revolution in military affairs, AAN forces will be required to plan, prepare, and execute significantly different and difficult missions. The tasks and missions may not necessarily be more difficult in terms of "steel on target," but more difficult in that the world will become increasingly complex and interrelated. The AAN will require soldiers clearly with a broader skill set, that is, with much more than marksmanship, communication, and battle staff skills. Developing environments, exercises, and performance measures that can represent the full range of AAN missions will not be easy. ARI can help by conducting human dimension research that can help define the requirements for the full range of missions.

As I have said throughout, much of this can be addressed by a careful AAN front end analysis that determines knowledge, skill, and ability requirements and by a strong, immersive training program. The AAN personnel development and training systems must, however, adequately represent most difficult AAN conditions.

For example, how do we select, develop, and train soldiers, leaders, and units to:

(1) Conduct MOUT operations with small forces and remote, precision fires,

(2) Fully rely on RC units and contractor support,

(3) Rapidly shift between fighting heavy larger forces, resolving conflicts, and peace operations,

(4) Win the tactical battle while strategically handling world news organizations, local political leaders, populations, and cultures.

Deploy ➡ Performance Eval

Develop a comprehensive performance evaluation system that addresses the full gamut of AAN missions, tasks, and conditions

* **Valid AAN performance measures are necessary for building personnel and training systems**
    - → **Individual skills, aptitudes**
    - → **Collective performance**
    - → **Leadership**
    - → **Adaptability**

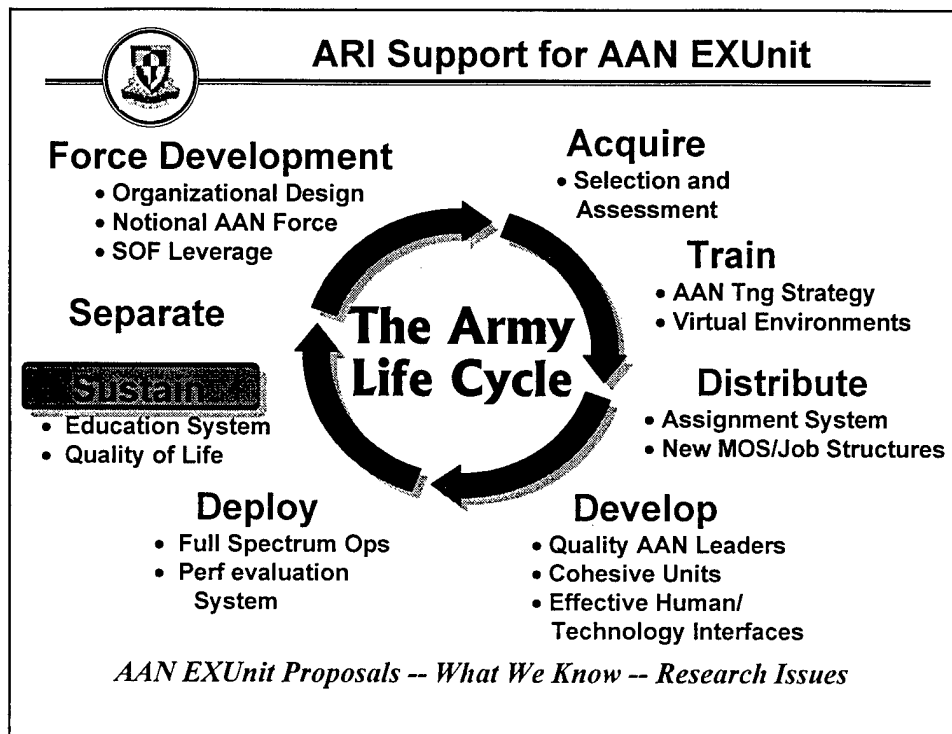* **Proficiency assessment system could facilitate AC/RC integration**

At issue:
How to represent and/or measure most difficult AAN missions, tasks, and conditions, e.g., adaptability, tactical & strategic decision-making

---

Similar to points made on the previous slide, we propose the need to develop performance measures that address the full gamut of AAN missions, tasks, and conditions. These measures are critical to most all of the AAN human dimension concerns, e.g., selection, assignment, training, virtual prototype comparisons.

The measures should focus on the most critical aspects of AAN missions and unit performance. These would include measures of individual knowledge, skills, and abilities, measures of collective performance, and measures of AAN leadership and adaptability.

Furthermore, if a comprehensive NCO and officer proficiency assessment system could be established to include, for example, staff and commander proficiency, then AC/RC integration problems could be reduced. If a soldier, leader, or unit, whether AC or RC, were certified as being competent, then they would be, de facto, ready for deployment.

Considerable research is needed as to how to represent and measure the most difficult AAN missions, tasks, and conditions. For example, how do we create scenarios that require soldiers and leaders to be adaptable or to demonstrate both tactical and strategic decision-making simultaneously? Then, how do we assess those characteristics?

32

ARI Support for AAN EXUnit

Force Development
- Organizational Design
- Notional AAN Force
- SOF Leverage

Acquire
- Selection and Assessment

Separate

Sustain
- Education System
- Quality of Life

Train
- AAN Tng Strategy
- Virtual Environments

The Army Life Cycle

Distribute
- Assignment System
- New MOS/Job Structures

Deploy
- Full Spectrum Ops
- Perf evaluation System

Develop
- Quality AAN Leaders
- Cohesive Units
- Effective Human/ Technology Interfaces

AAN EXUnit Proposals -- What We Know -- Research Issues

Lastly, I am going to talk about personnel system issues that are important for sustaining the AAN and future Army forces.

Sustain ➤ Education System

Assist the Army in a serious examine of the education system

- Re-look individual/collective and institutional/unit training matrix to determine what should best be trained where
- Graduation should be proficiency-based, not attendance-based
- Lay educational foundation for "Hyper-proficiency",
- Teach "how-to-learn" rather than specific bits of information

At issue:
(1) How to develop "Self-learners" that are prepared to capitalize on distributed training/Internet information?
(2) What are fundamental AAN prerequisite KSAs?
(3) What KSAs should be developed in non-AAN force as a feeder to AAN Teams and Assault Forces?

The Army needs to seriously reexamine its education and training system. This might well begin with a re-look of the individual/collective by institutional/unit training matrix. In general, there will almost certainly be a shift from institutional to unit training and research is needed to determine the best way to accomplish this. Many of the AAN skills will need to taught through immersive collective training in the unit settings. A new comprehensive system may better be thought of as a learning system, a system that seamlessly integrates education and training.

Graduation from the learning system should be proficiency-based, not attendance-based as our schools are fundamentally today. Also, if the system is to produce high levels of AAN performance or "hyper-proficiency," it should focus on delivering educational experiences targeted at high proficiency. For example, if CTC rotations are believed to be the near ultimate training event, we should try to replicate the CTC educational experience, or at least the CTC foundations, in the educational system. In addition, soldier performance during specified training events could be incorporated into decisions about his or her career path. If a soldier consistently excels or falters at some task, future job assignment could take that information into account.

Also, given that the AAN will require high degrees of flexibility and adaptability, the educational system should focus on teaching our soldiers "how to learn," rather than teaching them specific pieces of information. One of the most important educational research issues is how can we develop "self-learners," i.e., leaders and soldiers who have the skills to capitalize on distributed training opportunities and Internet-based information sources.

There is also to a need to determine what are the prerequisite knowledge skills and abilities required for the AAN. These AAN KSAs, along with the KSAs of the non-AAN Army, would be the foundational requirement for the Army education system.

Sustain ➤ Quality of Life

Determine quality of life issues that are peculiar to AAN

- Conduct comparative analysis of SOF quality of life issues versus those of total Army
- Use SOF community as testbed for proposed AAN programs

At issue:
Model for anticipating future quality of life issues

Quality of life issues will continue to be important in the AAN. If the Army is to attract and retain high-ability, high performing soldiers, then it must attend to the full range of quality of life issues, e.g., family, pay, career opportunities, personnel tempo.

Because of the apparent similarity between the SOF and projected AAN forces and missions, SOF may provide an initial model and test-bed for AAN quality of life issues.

Conclusions

- ARI is prepared to help lead the design and utilization of AAN EXUnit

- Training and personnel performance issues should be systematically addressed across the Army life cycle

- DOTLMS development should focus more on (T)raining, (L)eaders, and (S)oldiers

- The Army needs a unified champion for "Human Dimension" issues both for the nearer term and for the AAN

- Adequate AAN "Human Dimension" research funding is needed

In conclusion, we believe that the speed, complexity, and dispersion of the AAN environment will make human dimension issues more important than ever, and that the AAN EXUnit will provide the opportunity to empirically resolve many of the human dimension issues. Toward this end, ARI is prepared to help in the design and utilization of the AAN EXUnit. As I have discussed throughout, we believe that for the AAN and for the Army in general, training and personnel performance issues should be systematically addressed across the Army life cycle.

Also, regarding the development of the future Army, greater emphasis needs to be placed on the (T)raining, (L)eaders, and (S)oldier domains and relatively less on the (D)octrine, (O)rganization, and (M)ateriel domains.

To do this, the Army needs a unified champion for the "human dimension" TLS domains, both for AAN and in the nearer term. One of the primary functions of this organization would be to support the adequate funding of "human dimension" research.

While the challenges facing the AAN are great, they clearly do not have to be, nor will be, resolved overnight. To a large extent, the same research and planning methods that have produced the quality in today's Army and in Force XXI will continue to produce quality in the AAN.